An Interdisciplinary Analysis of Multispectral Satellite Data for Selected Cover Types in the Colorado Mountains, Using Automatic Data Processing Techniques

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A. Overall Status and Progress to Date

Hydrologic Features

An analysis of the SL-2 S-192 data's (unfiltered) noise characteristics is attached as Appendix I. This analysis was completed as part of the Hydrological Features Survey.

Topographic Modeling

Data Handling group support of the SKYLAB Colorado project consists of overlay and data transformation processing. Errors in the overlay of topographic data on June 1973 ERTS data were corrected by utilizing additional ground control points selected from the area of interest.

SKYLAB S192 data from August 1973 was reformatted and an overlay of this data onto ERTS data was carried out. The June data will be automatically registered once this overlay is completed in March.

Software for computing slope and aspect from the topographic data was brought on line in February and applied to the June data set. This transformation adds a slope, and direction of slope channels to the existing channels. The final June data set contains four ERTS channels, thirteen SKYLAB S192 channels, an elevation channel, slope channel and two aspects channels for a total of twenty-one.

Ecological Inventory

Two classifications on the SL-2 S-192 data and one classification of LANDSAT data were performed and compared during this reporting period for the Ecological Inventory. Training statistics for the 13 SKYLAB channels were calculated from the same resolution elements as those used in the LANDSAT I analysis. The training statistics for the LANDSAT I analysis were obtained using a modified clustering technique. A brief description of these analysis sequences follows.

A total of nine training areas, 40 data lines by 40 data columns, were selected, scattered throughout the Granite Peaks Test Site. Each training area was clustered independently into 12 to 15 cluster classes using the LANDSAT channels. The "optimum" number of cluster classes used for each training area was selected by minimizing the transformed scatter ratio proposed by Sindling-Larsen. Cluster classes were pooled from the different training areas using a transformed divergence measure. In a series of reiterations, class pairs with a transformed divergence of less than 1000, 1400, and 1650 were pooled. Twenty-nine informational spectral classes resulted from pooling the 130 cluster classes.

A statistics deck was developed from the SKYLAB-LANDSAT overlayed data (LARS Run 73034305). These statistics were developed by clustering only the LANDSAT data and using these fields to develop the statistics on all 17 channels of data.

These statistics were then used to perform a total of three classifications on each test field (see the October, 1974 Monthly Report for the procedure to select test fields). Each classification used four channels of data and the combinations were:

1) Channels 1,2,3,4 (the four LANDSAT bands)
2) Channels 7,11,12,15 (S-192, "Best four", 3,7,8,11)
3) Channels 7,9,10,12 (S-192, 3,5,6,8, which approximate the LANDSAT bands)

Table 1 is a summary of the classification test field performance at a Formation Level (Table 2). The overall test field performance is essentially the same for all three classifications. We had expected the LANDSAT classification to have a somewhat higher classification accuracy than the second SKYLAB classification since only the LANDSAT channels were used to cluster and pool the statistics. Also, we expected the slight registration error between the LANDSAT and SKYLAB data to lower the performance of the SKYLAB classifications. We also expected a lower performance with the SKYLAB data since this SL-2 data set has not been digitally filtered and several of the channels are obviously noisy. Therefore, these results with the SKYLAB data are considered to be very good, and offer considerable promise for more detailed analysis sequences.

These results will be examined in more depth in order to obtain an indication of the reason for these differences in classification. It is possible that we are looking at basic spectral differences of the materials and the instrument system parameters, or it is also possible that there is a registration problem between the cover type maps and the satellite data. These questions will be examined during March.

Geological Investigations

The task of correlating the various rock samples from the San Juan test site with their respective spectral properties is proving to be a more formidable undertaking than first planned. The complex minerology of these igneous rock samples must be better understood before a qualitative relationship between spectra and lithology can be obtained.

TABLE 1: Comparison of classification performance[a] of S-192[b] and LANDSAT-I[c] data using LANDSAT-I data for clustering and pooling.

	Channel Combinations		
		Best Four	Similar to LANDSAT
Formation	LANDSAT(4,5,6,7) 1,2,3,4	S-192(3,7,8,11) 7,11,12,15	S-192(3,5,6,8) 7,9,10,12
Ponderosa Pine	45.6	23.5	35.0
Doug & White Fir	85.3	90.5	89.8
Spruce & Fir	27.2	22.4	25.5
Aspen	21.4	14.3	15.6
Oak	60.9	70.1	65.8
Agricultural	50.0	77.1	66.7
Meadow	51.8	23.2	25.0
Water	100.0	97.4	95.7
Snow	100.0	100.0	100.0
Bareland	-	-	-
OVERALL	73.3	72.7	73.9
AVERAGE	60.2	57.6	57.7

[a]Test Field Performance Expressed as a Percent
[b]SL-2 June 5, 1973 Pass 5
[c]ID 1307-17204, June 5, 1973

LARS Run 73030305 Channel Definitions

1. .5-.6 μm LANDSAT
2. .6-.7 μm LANDSAT
3. .7-.8 μm LANDSAT
4. .8-1.1 μm LANDSAT
5. (1) .41-.46 μm S-192
6. (2) .46-.51 μm S-192
7. (3) .52-.56 μm S-192
8. (4) .56-.61 μm S-192
9. (5) .62-.67 μm S-192
10. (6) .68-.76 μm S-192
11. (7) .78-.88 μm S-192
12. (8) .98-1.08 μm S-192
13. (9) 1.09-1.19 μm S-192
14. (10) 1.20-1.39 μm S-192
15. (11) 1.55-1.75 μm S-192
16. (12) 2.10-2.35 μm S-192
17. (13) 10.20-12.50 μm S-192

TABLE 2: Breakdown of Vegetation Types

Biomes	Formation
Coniferous Forest	Spruce-fir
	Douglas & white fir
	Ponderosa Pine
	Pinyon-Juniper
Deciduous Forest	Aspen
	Riparian
	Oak-Mahogany
Tundra	Bare land
	Alpine meadow
	Snow & ice
Grassland	Meadow
	Agricultural
Water	Water

The structural mapping on the 1:250,000 scale, S-190B photographs of the San Juan test site has been completed. There was some difficulty in mapping the northwestern portion of the test site because of cloud cover. Two channels of S-192 data (5 and 11) are being prepared for lineament and structural mapping at the same 1:250,000 scale. This will be compared with the S-190B features, published features and features mapped on ERTS.

Several portions of the S-192 data were selected for processing with our ratio processor and the following ratios performed: 3/8, 4/7, 5/10, 6/11, 3/5, 5/6, 6/8, 3/7+9+11; 5/7+9+11; 6/7+9+11 and 8/7+9+11.

B. Recommendations

None

C. Expected Accomplishments

Overlay and slope-aspect calculations for the August data should be completed by the end of March. Software development is also being carried out to define bands of elevation, slope and aspect to group these variables in ranges specified by the user.

For the classification task for the Ecological Inventory the next step will be to cluster and pool the SKYLAB data, then classify the same test fields with the same channel combinations to see if this will improve the SKYLAB classifications.

D. Significant Results

There are no author-identified significant results in this report.

E. Travel

D. W. Levandowski was at the Kansas Remote Sensing Conference February 18-20 to give a report on preliminary results from his SKYLAB investigations. On February 27, Dr. R. M. Hoffer met with Dr. Rigdon Joosten at JSC/Houston. Dr. Hoffer was at JSC for another meeting and took advantage of this opportunity to discuss the general status of the SKYLAB activity. The discussion proved fruitful.